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Ministry of
Community and
Social Services

Honourable John Sweeney
Minister

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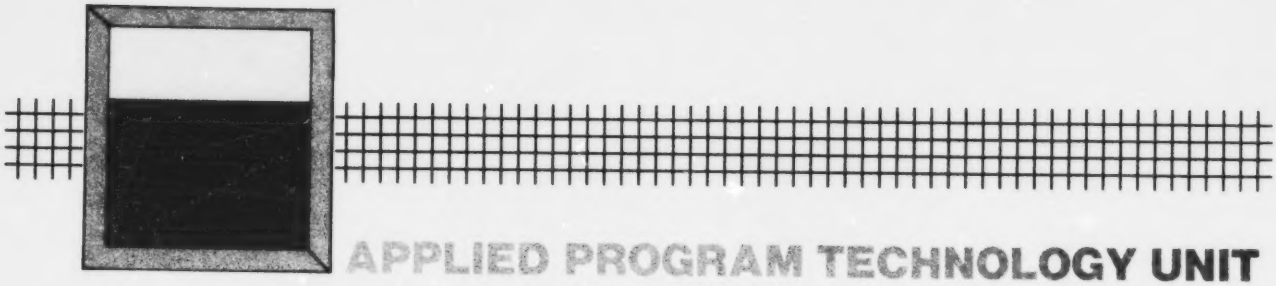
VOICE RECOGNITION TECHNOLOGY AS AN ASSISTIVE DEVICE IN THE EMPLOYMENT OF SEVERELY PHYSICALLY DISABLED PERSONS–

A DEMONSTRATION PROJECT



APPLIED PROGRAM TECHNOLOGY UNIT

VOICE RECOGNITION TECHNOLOGY AS AN ASSISTIVE DEVICE IN THE EMPLOYMENT OF SEVERELY PHYSICALLY DISABLED PERSONS - A DEMONSTRATION PROJECT

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SUMMARY

The purpose of this project was to assess the work performance and experience of a quadriplegic man who was trained to use the voice recognition system (VRS) for computer programming.

In 1980, Lew Boles, a high level quadriplegic, was hired by Systemhouse Inc. as a junior computer programmer. Having to use a mouthstick to press the keys on the computer keyboard was a major impediment to Lew's productivity. Despite his best efforts, he could not complete the projects he began. It was recognized that Lew's productivity could be increased if he were able to program the computer without relying on a standard keyboard. The Micro and Audio Recognition Systems for the Handicapped (MARSH) Project, initiated by Systemhouse Inc. and carried out in co-operation with MCSS and IBM Canada Ltd., was based on the expectation that voice recognition technology might provide a satisfactory system of bypassing the keyboard.

The project demonstrated that the VRS increased Lew's efficiency in computer programming. It did not fully compensate for his physical handicap and he still could not compete on equal terms with a non-disabled computer programmer on keyboard intensive tasks. However, on those activities that require a good understanding of complex software or strong analytic ability, Lew would be as productive as non-handicapped computer professionals. Furthermore, the VRS did open up the possibility of Lew being employed as a consultant to microcomputer users who are not computer specialists. While Lew cannot compete in terms of speed, he can in terms of knowledge. In the area of assisting other computer users, his skills would be comparable with those of other consultants.

THE PROJECT

Background[1]

The Micro and Audio Recognition Systems for the Handicapped (MARSH) project was initiated by Dennis Maloney, General Manager at Systemhouse Inc. (SHL)[2] It focuses on Lew Boles and his work as a computer programmer. Since 1980 Lew has been employed by SHL as a junior programmer.[3] He works from an office in the Queen Elizabeth Hospital, where he lives as a chronic-care patient. Lew is a high level quadriplegic.[4] Over the past five years, Lew has worked on a number of software contracts. Although he demonstrated good knowledge, ability, and data processing aptitude, he was less productive than his non-handicapped peers. The problem was in the technology: using a mouthstick to press the keys one at a time on the computer keyboard was a major impediment. Determined to find a means of assisting Lew, his new manager, Dennis Maloney, identified a technology, specifically, the voice recognition system (VRS), that would allow Lew to program the computer by voice and thus liberate him from the standard keyboard.

SHL proceeded to secure an agreement from IBM Canada Ltd. (IBM) for them to loan a personal computer (the IBM PC-XT) to Lew for use with the VRS. SHL then contacted the Ministry of Community and Social Services (MCSS) to explore the possibility of purchasing the VRS for Lew through Vocational Rehabilitation Services. After the purchase was approved, the Program Technology Branch of MCSS agreed to assess Lew's ability to use the VRS in conjunction with the IBM PC-XT. This report is an outcome of the assessment.

The decision of the Branch to participate in the MARSH project is consistent with MCSS corporate strategies as outlined in the document Corporate Strategies: Implementation. This document articulates the commitment of MCSS to develop services in a way

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[1] The Background, Rationale, and Objectives sections of this report are based largely upon documentation submitted by project participants. See also Appendix F on the description of the project in Window.

[2] Systemhouse Inc. is a company that designs, develops and integrates computer-based information systems.

[3] A junior programmer is responsible for the development of models to meet clients' requirements.

[4] Lew can move only his head, neck, and shoulders. See Appendix G for a history of Lew Boles.

that will enhance the self-reliance of the individuals it serves. The corporate strategies include initiatives to be undertaken with the goal of supporting independent living for as many MCSS clients as possible.

The Branch identified three strategic sectors for the 1985/86 work plan:

I. To promote the development of program technologies that will enhance the daily living capabilities of individuals and families;

II. To promote the development of program technologies that will enhance the employment capabilities of individuals; and

III. To investigate emerging program technologies that may enhance the self-reliance of individuals and families.

With the emphasis on the second strategic sector, the Branch agreed to undertake the MARSH project and consequently to assess the potential of the VRS to increase the productivity of physically disabled adults in the workplace.

Rationale

Assistive devices, computers, robots, and workplace technologies are increasingly being used to benefit workers who have physical impairments. The assumption is that these technologies can compensate for disabilities such as limited physical strength, dexterity, eyesight, or hearing and can help improve employment prospects for persons who, because of their disability, might otherwise be unemployable.

Among the many workplace technologies, the personal computer is one that is showing increasing potential for enhancing the employability of disabled persons. Through a variety of hardware products and software packages, appropriate adaptations are being made to meet the needs of users who have various handicaps.

One recent innovation in personal computing technology is voice recognition. Voice recognition enables individuals to train computers to recognize voice instructions and to convert the instructions into computer commands.

The potential use of voice recognition technology for the disabled in the workplace is the subject of the MARSH project. Specifically, the project is a comprehensive assessment of the experiences of a quadriplegic man, Lew Boles, who was trained to use the VRS for computer programming.

Objectives

The project has two principal objectives:

1. To evaluate Lew Boles' use of the VRS for computer programming.

2. To determine if the VRS allows physically handicapped people to be competitive with their peers in the field of computer programming.

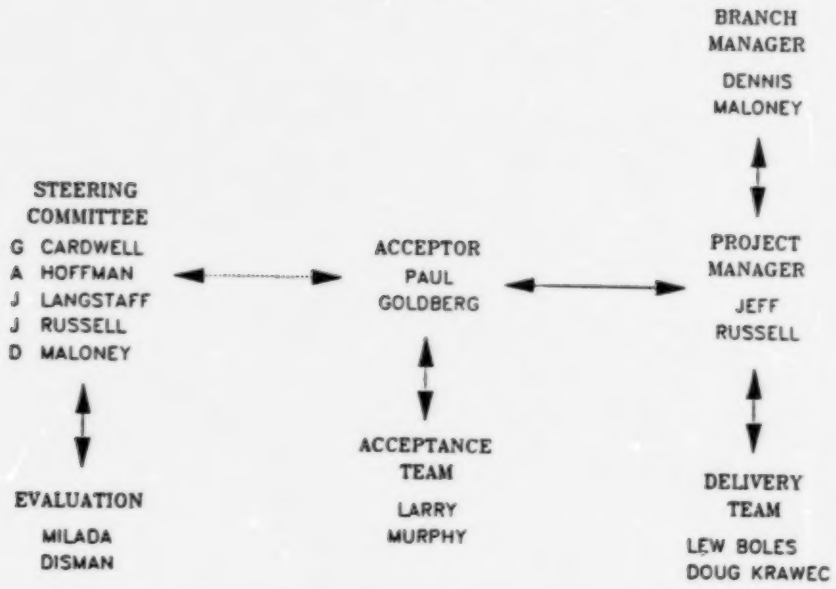
Project Tasks and Responsibilities

The project centred on the learning process and the work performance of Lew Boles. It was managed by a SHL consultant, Jeff Russell, and monitored by a Steering Committee made up of representatives of SHL (Dennis Maloney, Jeff Russell), IBM (John Langstaff), and MCSS (Dr. Arlene Hoffman, Gordon Cardwell). The project was given additional support by the staff of the Queen Elizabeth Hospital. The assessment, conducted by an outside consultant, was managed by the Program Technology Branch, Information Systems and Applied Technology, with consultation from the Research and Program Evaluation Unit. Those persons managing and monitoring the project comprised the project team.

See Figure 1, for the project team's organizational chart.

Figure 1

PROJECT ORGANIZATION CHART
MARSH PROJECT



The tasks and responsibilities of the project participants are listed in Table 1.

Table 1

TASKS AND RESPONSIBILITIES OF PROJECT PARTICIPANTS[5]

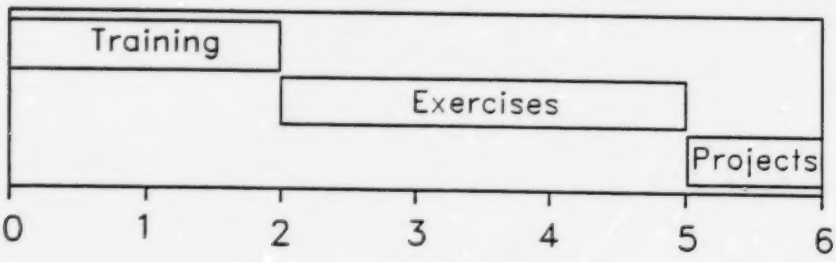
		SHL	IBM	MCSS
1.	Project Management and Integration Services (15 person-days)	X		
2.	Salary to Lew Boles (6 months)	X		
3.	Provision of Microcomputer ($10,000)		X	
4.	Provision of Voice Recognition Equipment ($4,000)			X
5.	Training on PC and Software	X		
6.	Provision of Training Exercises (5 person-days)	X		
7.	Evaluation of Project and Preparation of Report (26 person-days)			X

Project Phases and Time Frame

The project consisted of three phases:

Figure 2

PROJECT PLAN (MONTHS)[5]



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[5] By Jeff Russell, Systemhouse Inc. (SHL)

1. Training Phase

Training activities took place over a two-month period:

1) on the VRS in conjunction with the IBM PC-XT;

2) in the use of MS-DOS[6];

3) in the use of Lotus 1-2-3;

4) in the use of Telephone Manager;

5) reading software manuals.

2. Exercises Phase

During this three-month phase, three Lotus 1-2-3 projects were to be completed as training exercises[7].

3. Project Phase

A further three Lotus 1-2-3- projects were to be completed to serve as the basis for the evaluation. The MARSH project was scheduled to begin on August 15, 1985, and to finish on February 16, 1986. All projects were completed by April 9, 1986. The Steering Committee realized that completion of two projects would provide enough data for evaluation purposes and so the third project was cancelled. The project concluded with a Steering Committee meeting on May 1, 1986. The project schedule was extended for two reasons: Lew was incapacitated by illness for several weeks, and a number of demonstrations of the VRS were held for approximately 100 visitors[8].

Considerable time was required for preparation and presentation of the demonstrations, and the original time schedule did not allow for this.

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[6] See Appendix B for a description of the software programs.

[7] See Appendix C for a description of the 1-2-3 projects.

[8] The demonstrations were attended by people from the following institutions: Hugh MacMillan Medical Centre, IBM, MCSS, Neil Squire Foundation, Queen Elizabeth Hospital, and SHL. Detailed discussion of the demonstrations is beyond the scope of this report, but it is of interest to note that visitors conveyed extremely favourable impressions of Lew's use of the VRS.

THE VOICE RECOGNITION SYSTEM (VRS)

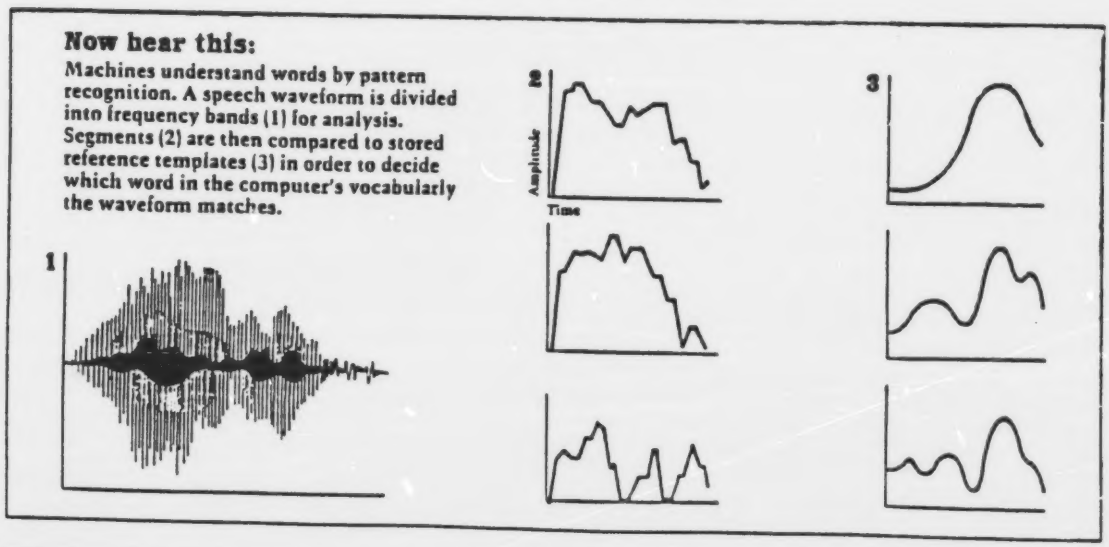
Voice recognition systems generally consist of both hardware and software.[9] The hardware usually is in the form of an expansion card that is plugged into the host computer. The software component consists of a program that trains the user and the hardware to operate as one. The software retains the user's voice patterns, as well as literal words and phrases assigned to each pattern.

The VRS is speech-activated. Speech activation is basically pattern recognition. The speech is converted to wave form input and assigned a digital representation based on the wave form pattern.

During a training session with the VRS and the personal computer, the user speaks a chosen word into the microphone that results in the creation of a wave pattern. The same word or phrase is repeated several times, with the system converting each utterance into a wave form and finally creating a single template for storage.

Figure 3

SPEECH PATTERN RECOGNITION[10]


Now hear this:
Machines understand words by pattern recognition. A speech waveform is divided into frequency bands (1) for analysis. Segments (2) are then compared to stored reference templates (3) in order to decide which word in the computer's vocabulary the waveform matches.
1
2
Amplitude
Time
3

---

[9] The following description was adapted from Bud Rizek and Harry Hiner, "Voice Activated Computing," Closing the Gap, June/July 1985, pp. 19-20.

[10] Kathleen K. Wiegner, "If machines could hear, pigs could fly," Forbes, Dec. 31, 1984, pp. 118-119.

During the actual operation of the speech activation system, each active utterance by the user is converted, as described above, then compared to each and every template previously recorded. If any of the patterns command within specified parameters, the computer prints or carries out the command associated with that particular utterance.

The VRS selected for Lew was the VPC 2000 and response system, developed by the VOTAN company and available from VOTEK Co. in Canada. The specifications[11] of the VPC 2000 are as follows:

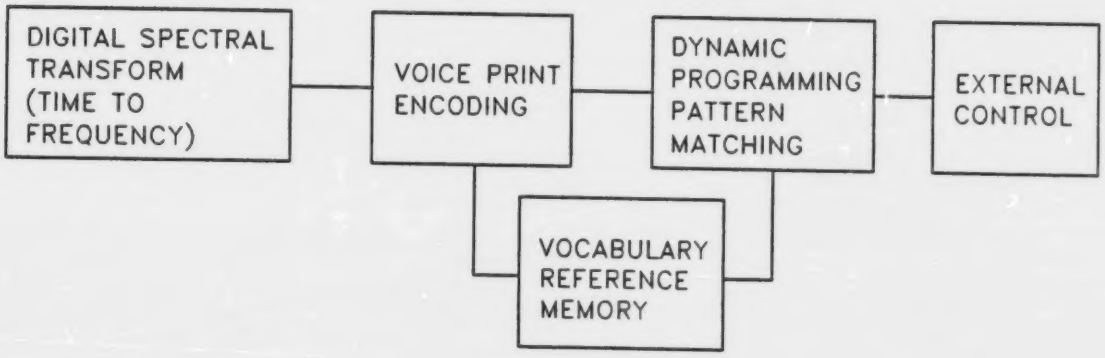
The VPC 2000 VOICE CARD from VOTAN is a hardware and software system that adds complete input/output and telephone management capabilities to the IBM and compatible personal computers.

Featuring continuous speech recognition, the VOICE CARD enables the user to speak in a natural, conversational flow, rather than pausing between each word. VOTAN's Voice Key Software allows the user to incorporate voice capabilities into existing software packages, without any modification to the application software itself.

The recognizer operation, shown in Figure 4, provides a graphic representation of the recognition process.

Figure 4

THE VOTAN VOICE RECOGNITION PROCESS[11]



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[11] Adapted from VOTEK's pamphlet on the VPC 2000 and from John P. Carter, Electronically Hearing: Computer Speech Recognition, (Indianapolis, W. Sams & Co., Inc., 1984), pp. 191-193.

The VPC 2000 consists of a printed circuit board that plugs into any of the long auxiliary system slots. Microphone, speaker, and complete software and documentation are included.

Available software for the system, which features speaker-dependent word recognition, voice response, and word coding, allows the user to manipulate words within a vocabulary file, add or delete from a file of voice messages, and even swap templates in and out of vocabulary memory, through a single command.

The VPC 2000 VOICE CARD supports the following speech technologies and capabilities:

Continuous Speaker-Dependent Recognition. Allows previously trained words from a user's library of word templates to be recognized. The VOICE CARD holds up to 64 trained words available for matching at any instant. With virtual swaps of vocabulary subsets to and from the VOICE CARD, the vocabulary for an application can be any size.

Voice Response and Voice Store and Forward. Human-sounding voice output for operator prompting, feedback, and messaging is provided. High quality, digitized, compressed speech is available at user-selectable rates of 4000 to 14,400 bits per second.

Telephone Management Facilities. Complete telephone interfacing capabilities are provided, including auto answer, auto dial, call progress monitoring, busy signal, ring and speech response detection, programmable ring time out, and pauses. All special functions, including speech recognition, are operable over standard telephone lines from remote locations.

Voice Key Software. With Voice Key, most application packages relying on ROM BIOS[12] calls for input can become "voice driven". The majority of commercially available software packages written for the IBM-PC and compatibles operate in this manner. The user defines up to 64 voice utterances for each application program. Key stroke sequences of up to 30 characters are assigned to each utterance. At run time, the keyboard is completely active and can be used normally while the VOICE CARD simultaneously "listens" for voice commands from the user. When the user speaks any pre-defined utterance, the key strokes linked to that utterance are typed automatically by the Voice Key. For each utterance, the user chooses whether or not to hear voice response messages to confirm the voice command.

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[12] ROM = read-only memory; BIOS = basic input/output system.

Telephone Manager Software. This program gives immediate access to the telephone management hardware facilities. The complete telephone management capability turns the PC into a voice mail system: the VOICE CARD supports data retrieval and access from virtually any telephone in the world, through speaker-dependent voice recognition.

With the VPC 2000, speed and efficiency on the PC can be achieved without the user being a touch typist; in fact, most command functions may be implemented without ever touching the keyboard.

THE ROLE OF THE EVALUATOR

The evaluator's role with respect to the MARSH Project was to design and initiate the evaluation of Lew Boles' experience using the VRS. An additional responsibility of the evaluator was to provide recommendations relating to the future use of the VRS by other quadriplegics in the workplace and the selection of appropriate individuals to use it.

The evaluation of the project addresses substantive issues of skill-acquisition, as well as issues such as time allotted to various tasks within the project's stages.

THE EVALUATION

The specific objectives for the evaluation, as identified in MCSS's Terms of Reference, are as follows:

1. To determine whether Lew can adequately use voice recognition technology with a personal computer to fulfill the employment requirements of a junior computer programmer;

2. To determine the benefits and problems experienced by Lew in using the technology;

3. To determine the training time necessary to become proficient in the technology;

4. To determine Lew's level of productivity and changes in productivity over time. Two points in time are considered: the period prior to his using voice recognition technology, and the period during which he used it;

5. To determine changes, if any, in Lew's morale over time. Two points in time are considered: the period prior to using his voice recognition technology, and the period during which he used it;

6. To determine the factors that require consideration in conducting assessments aimed at determining the usefulness of voice recognition technology for disabled individuals in the workplace.

A number of issues relate to each objective of the evaluation.[13]

1. Issues Related to Objective 1
   - To what extent is Lew able to complete projects assigned to him?
   - To what extent are the projects assigned to Lew competently completed?
   - To what extent are Lew's employers and clients satisfied with his productivity?

2. Issues Related to Objective 2
   - What does Lew perceive to be the advantages of using voice recognition technology for computer programming?
   - What does Lew perceive to be the major difficulties in using voice recognition technology for computer programming?

3. Issues Related to Objective 3
   - How long did it take Lew to become proficient using the technology?
   - What, if any, were the obstacles in the training program?

4. Issues Related to Objective 4
   - How many hours per day is Lew able to work?
   - How does Lew compare with other computer programmers in terms of the time required to complete a project?
   - What are the major factors that affect Lew's level of productivity?
   - What is Lew's level of motivation?

5. Issues Related to Objective 5
   - What is Lew's level of job satisfaction, as measured at two points in time: the period prior to his using voice recognition technology, and the period during which he used it?

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[13] As identified by MCSS.

- Does the change in Lew's job contribute to Lew's feeling of independence and self-worth, and, if so, how?

6. Issues Related to Objective 6
   - What social, health, motivational, and other factors should be considered in assessing a disabled person's capability of benefitting from voice-recognition technology in the work place?

Methodology[14]

During the month before the project began, the evaluator carried out the following activities:

- a review of the literature on the use of the VRS with microcomputers, specifically, as it is used by the disabled;
- a review of existing documentation on Lew;
- interviews with Lew;
- interviews with Lew's managers at work;
- consultation with MCSS project management staff;
- interviews with those involved in Lew's participation in the work force before the start of this project;
- interviews with the floor nursing supervisor and social worker attending Lew in the Queen Elizabeth Hospital;
- identification of a method for data collection;
- identification of the evaluation criteria.

The evaluator's tasks during the project were:

- monitoring Lew's work activities;

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[14] The literature reviewed does not provide a methodology for the assessment of handicapped persons in the workplace. Stephanie Heyes, who assesses the handicapped in the Bloorview Hospital, pointed out that the few existing articles on the subject were outdated by the time they were published. Specifically, she commented on the lack of any special scales assessing morale of disabled workers. Furthermore, she does not believe in the predictive power of scales, and suggests an interview as the preferable method for assessment.

- preparing monthly progress reports on these activities;

- presenting the progress reports at the monthly meetings of the project's Steering Committee;

- carrying out additional interviews with Lew's managers;

Data Collection

The evaluation is based upon the collection of data from five sources:

- interviews with Lew;

- Lew's journal;

- interviews with Lew's managers;

- interviews with people involved in Lew's work history;

- a review of the literature.

The monitoring of Lew's learning progress and job performance was undertaken through a series of focussed interviews with Lew, and through an examination of his journal.

Lew was asked to keep a tape-recorded journal of his work and activities. Each workday, two entries were made: at the beginning of his workday, Lew stated his expectations of the particular tasks he intended to undertake on that particular day, and noted any personal or telephone interactions planned; at the end of his workday, Lew commented on how his expectations were met, what tasks were or were not possible to finish, and what work activities he planned for the following day.

Focussed weekly interviews with Lew provided an opportunity to discuss the content of his journal from the previous week, and to demonstrate various tasks using the VRS. From the journal and the interviews, quantitative documentation pertaining to Lew's work tasks and job-oriented interactions was developed.[15]

Additionally, Lew's progress was followed by SHL, using weekly worksheets.

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[15] See the section on Findings.

Evaluation Criteria

The criteria identified for evaluating Lew's experience using the VRS were developed on the basis of the related issues, as well as the structure of the project itself. Evaluation criteria were developed to assess each of the three phases as well as the differences in work experience prior to and during the use of the VRS.

Phase I

The training period consisted of the formal training of Lew by Miriam Hurrell, marketing representative from VOTEK; Lew's "training" of the computer; and Lew's studying of instructional materials.

Phase I was evaluated using the following measures:

1. Length of training

   a) Formal training by VOTEK

      Number of hours Miriam Hurrell spent with Lew teaching him to use the equipment.

   b) "Training" the computer

      Number of hours Lew spent "training" the computer.

2. Number of workdays

   Total number of days Lew spent on training tasks.

3. Number of workhours

   Total number of hours Lew spent on training tasks.

4. Number of contacts with VOTEK, IBM, SHL

   a) Phone calls

   b) Visits

      Total number of times a person from VOTEK, IBM, or SHL was in telephone contact with Lew or visited his office

5. Attitudes toward the learning process

   a) Motivation

      Lew's desire to work with the VRS on the PC-XT

   b) Morale

      Lew's outlook described as a continuum from pessimism to optimism.

   c) Satisfaction

      Lew's expression of feelings on a continuum from dissatisfaction to satisfaction.

6. Mastery of the VRS with the PC-XT

   Ability to operate the PC-XT with the VRS to use MC-DOS, Lotus 1-2-3, and Telephone Manager.

Phase II

This phase was developed to provide Lew with exercises 1, 2 and 3, prior to performing specific projects.[16]

The following measures were used to evaluate Phase II:

1. Number of exercises completed

   Total number of exercises assigned to Lew by SHL and completed by him.

2. Length of time to complete each exercise as well as to train voice templates

   Total number of hours required to complete three exercises and total number of hours required to train voice templates.

3. Number of workdays

   Total number of days Lew spent on exercises and related tasks

---

[16] See Appendix C for a description of the exercises and projects.

4. Number of workhours

   Total number of hours Lew spent on exercises and related tasks

5. Number of contacts with VOTEK, IBM, SHL

   a) Phone calls

   b) Visits

      Total number of times a person from VOTEK, IBM or SHL was in telephone contact with Lew or visited his office

6. Productivity

   Productivity in relation to the three exercises was indicated by the number of hours spent on the job as recorded on the weekly worksheets for SHL employees. The exercises were developed specifically for the MARSH project. SHL assessed productivity on the basis of completion, accuracy, and efficiency on the job.

Phase III

This phase was designed to provide Lew with projects 1 and 2. Phase II was evaluated by the following measures:

1. Number of projects completed

   Total number of projects assigned to Lew by SHL and completed by him.

2. Length of time to complete each project

   Total number of hours required to complete projects 1 and 2

3. Number of workdays

   Total number of days Lew spent on projects and related tasks

4. Number of work hours

   Total number of hours Lew spent on projects and related tasks

5. Number of contacts with VOTEK, IBM, SHL

   a) Phone calls

   b) Visits

      Total number of times a person from VOTEK, IBM, or SHL was in telephone contact with Lew or visited his office

6. Accuracy of final products

   Degree to which SHL indicated that project was completed to acceptable standards

7. Productivity

   Number of hours Lew spent completing the two projects in comparison with another SHL non-handicapped employee using a standard key-board.

Comparison of Two Work Periods

The period prior to Lew's use of the VRS and the period of his use were compared in order to understand the difference the VRS made in Lew's actual work experience as an employee of SHL.

1. Satisfaction

   Lew's expression of satisfaction with his work experience prior to use of the VRS and during the use of the VRS.

2. Productivity

   Number of projects completed by Lew as an employee of SHL prior to and after using the VRS.

FINDINGS

Phase I

Training Lew to Use the VRS

The original plan for the MARSH project allocated two months for training Lew in the use of the VRS (see Figure 2, page 5), the microcomputer, and selected software programs. It was intended that, during these months, Lew would learn to use the VRS under the guidance of Miriam Hurrell.

In fact, Lew learned to use the VOTAN VRS 2000 during one two-hour session with Miriam. At the conclusion of this session, he was familiar with the principles of the VRS, and had installed the voice-command templates needed for MS-DOS and Lotus 1-2-3 (that is, had replaced the board keys with voice keys so that the computer would "recognize" his voice commands).

"Training" the Computer

Creating voice keys includes the following steps:

- a label "to be voiced" is entered via the keyboard;

- this label is then linked with a definition of what the computer is supposed to "recognize" under that label; and

- the label is repeated verbally, in order to "train" the voice template to subsequently recognize the label.

The salient feature of working with the VRS is the modification of the templates. When there is an error in voice recognition, the voice templates must be "returned" by deleting the existing voice-prints and again vocalizing the label or the command words that need modification.

Voice templates must be modified for the following reasons:

- a new programming task may require the creation of new voice key files;

- occasionally, better recognition of the voice commands is needed (e.g., during the MARSH project, some of the commands had to be "retrained" twice);

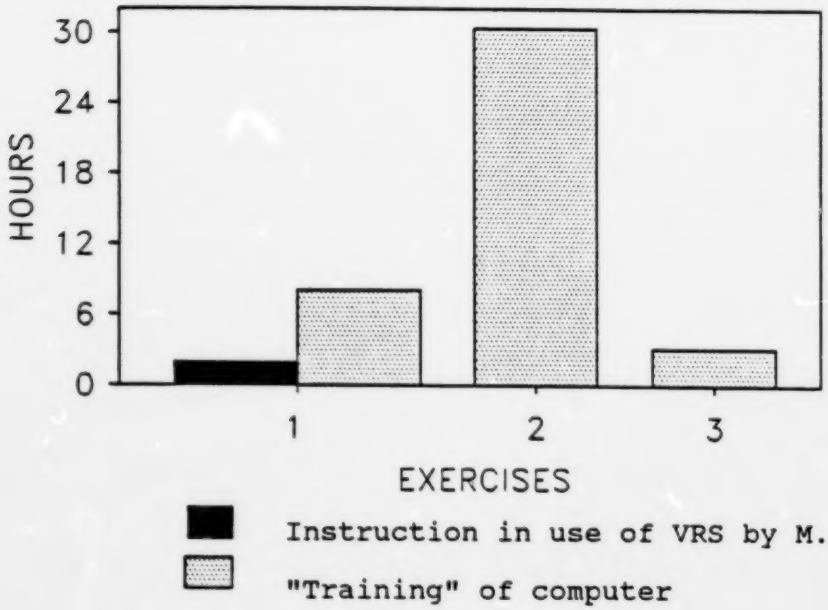
- since after about six months, the templates do not retain the electronic imprint with the original clarity, the voice commands are not recognized as accurately or as consistently as before - it is therefore recommended that templates be "retrained" about twice a year;

- the VRS is sensitive to voice modulation and enunciation - as the user's voice alters over time, modification is necessary.

"Training" the computer requires more time than training the user. This feature is also highlighted in Figure 5, (on page 19) which compares the time to train Lew on the VRS (two hours) and number of hours Lew spent "training" the computer (8.1 hours for exercise 1, 30.4 hours for exercise 2, and 3.2 hours for exercise 3).

Figure 5

HOURS SPENT TRAINING ON THE VRS
AND "TRAINING" THE COMPUTER IN PHASE 1



Learning Related Activities

The rest of the training period was spent on Lew's learning related activities. These included: studying the manual for the VRS, learning to use Telephone Manager, learning MS-DOS, studying the MS-DOS manual and the interactive tutorial, studying the Lotus 1-2-3 interactive tutorial, and practicing Lotus 1-2-3.[17]

The Phase I training period lasted 36 workdays, totalling 108.25 workhours, with an average workday lasting 3.01 hours (see Table 2, page 22).

Total number of contacts with VOTEK, IBM and SHL was 41, including 29 phone calls (nine with VOTEK, four with IBM, and sixteen with SHL) and 12 visits (three visits from VOTEK, one from IBM and eight from SHL). The contacts were for the purpose of clarifying use of the equipment and the content tasks.

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[17] See Appendix B for description of Lotus 1-2-3 and MS-DOS. The interactive tutorial is a computer assisted tool, used for learning application programs. For example, the Lotus 1-2-3 interactive tutorial simulates basic input and control operations for the program.

During the training period, Lew appeared to be highly motivated, continuously expressing desire to work on the VRS with the PC-XT. He was very optimistic about his ability to learn to operate the computer and expressed satisfaction with his learning progress.

At the end of the training period, Lew was able to operate the PC-XT to use MS-DOS, Lotus 1-2-3, and Telephone Manager.

Phase II

The exercises period lasted 41 workdays, totalling 149.83 workhours, with an average workday lasting 3.65 hours (see Table 2, page 22).

The three exercises and related modifications of voice files were completed during this phase.

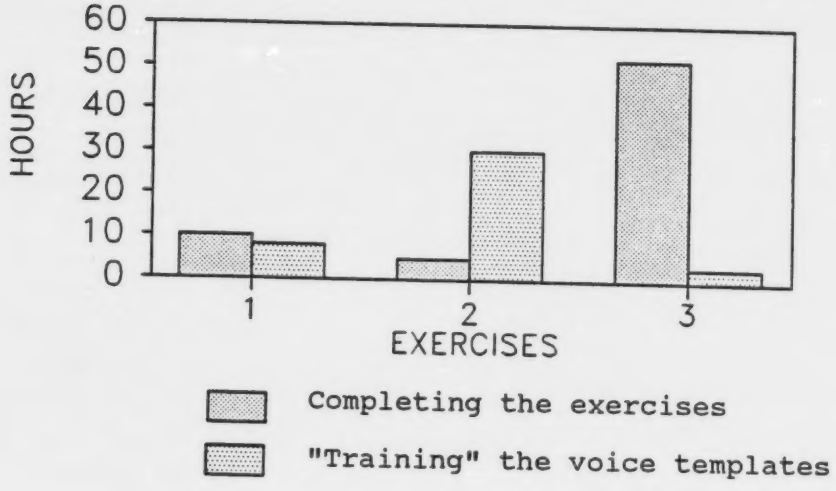
Figure 6 depicts the number of hours spent on completing the three exercises and modifying the voice templates.

The three exercises were completed in 67.2 hours: 10.1 were spent on exercise 1, 4.9 on exercise 2, and 52.2 on exercise 3. Creating the voice templates took 41.7 hours: 8.1 for exercise 1, 30.4 for exercise 2, and 3.2 for exercise 3.

The greater time necessary to create voice key files for the second exercise, as compared with the other two, is attributed to the additional voice keys needed to meet the specific requirements of the exercise.

Figure 6

HOURS SPENT COMPLETING THE THREE EXERCISES AND TRAINING THE VOICE FILES IN PHASE II



The amount of time required to modify the voice templates as compared with the time required to complete the three exercises points out how time-demanding the training of the voice templates is. Modifying the voice templates is a salient feature of VRS use.

Total number of contacts with VOTEK, IBM and SHL was 41, including 32 phone calls (three with VOTEK, five with IBM, and twenty-four with SHL) and nine visits (all from SHL).

Managers from SHL indicated that all three exercises were completed efficiently and with 100% accuracy.

Phase III

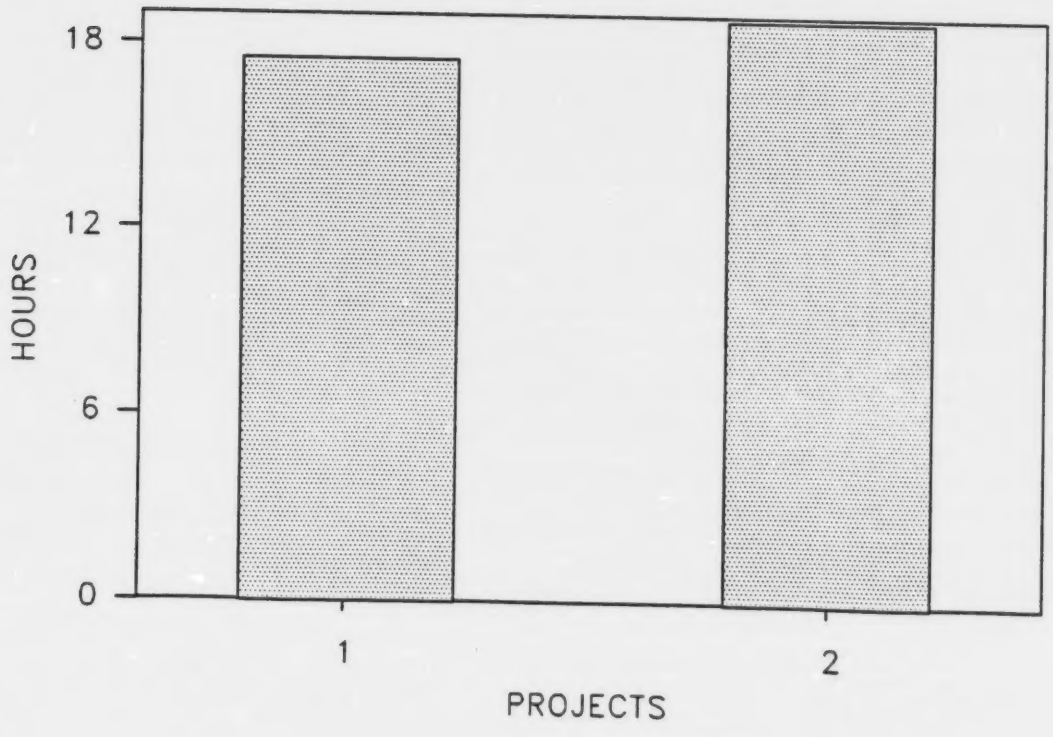
The project phase lasted 16 workdays, totalling 55.38 workhours, with an average workday lasting 3.46 hours.

This phase involved the completion of the two projects.

Figure 7 shows the number of hours spent on the completion of each project: 17.5 for project 1, and 18.8 for project 2.

Figure 7

HOURS SPENT ON EACH PROJECT IN PHASE III



The time on the second project was affected by Lew's having to learn accounting skills in addition to the programming techniques.

Total number of contacts with VOTEK, IBM and SHL was eight, including six phone calls (one with VOTEK and five with SHL) and two visits (both from SHL).

SHL employers indicated that the two projects were completed efficiently and with 100% accuracy.

Productivity in the development of the two projects was determined by comparing the time spent on the projects by Lew with the time spent by another SHL programmer. In the first project, the non-handicapped worker was 18.9% faster, and in the second project 29.8% faster.

Table 2.

TIME SPENT BY LEW TO COMPLETE PROJECTS 1 AND 2 COMPARED WITH TIME SPENT BY ANOTHER SHL EMPLOYEE USING A STANDARD KEYBORAD

PROJECT 1: POLYSAR RUBBER GRADING TEST GRAPHS	
Time to Complete	
Lew Boles	17.5 hours
Other Programmer	14.2 hours
Difference	3.3 hours
PROJECT #2: GROUPMARK FINANCIAL FORECASTING MODEL	
Time to Complete	
Lew Boles	18.8 hours
Other Programmer	13.2 hours
Difference	5.6 hours

Comparison of Two Work Periods - Prior and During Lew's use of the VRS

Prior to using the VRS, Lew was not able to finish any of his assignments and consequently he and his employer were

disappointed. During the MARSH project, Lew's morale was consistently high, as noted in his journal entries, in the observations of his employers, by the staff of Queen Elizabeth Hospital, and by this evaluator. He had an optimistic outlook on his progress.[18]

Lew's productivity as a computer programmer was examined prior to his using the VRS and during his use of it. Since Lew worked on different tasks, his speed of completion could not be measured. The only point of comparison possible was the number of projects completed. Prior to working on the VRS, Lew completed none. Working with the VRS, Lew completed the three exercises and the two projects assigned. This change likely resulted from the increased speed with which Lew was able to operate the PC-XT using the voice commands, as compared with the slowness of operating the computer with the mouthstick.

Summary Statements

The three phases of the MARSH project took a total of 93 workdays, or 313.46 hours, with an average workday of 3.37 hours (see Table 3, and Figures 8, 9 and 10, Appendix A, page 29).

During the three phases, ninety contacts were made (0.97 contacts per day), including sixty-seven phone calls (thirteen with VOTEK, none with IBM, and forty-five with SHL), and twenty-three visits (three from VOTEK, nine with IBM, and nineteen from SHL) (see Figure 11, Appendix A, page 34).

By the end of the three phases, Lew could:

- use the VRS to program a personal computer;
- program Lotus 1-2-3 to the level of tasks required in the three exercises and two projects assigned;
- operate the Telephone Manager facilities from his office or from a remote location.

Lew achieved a high level of proficiency in using the VRS; all his acquired skills were utilized during the MARSH project and will continue to be utilized in his future work.

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[18] If Lew had any "down days," they may have occurred while he was incapacitated by skin sores. If there was any change in morale, Lew was determined not to reveal it, remaining outwardly cheerful and claiming to take "one day at a time."

Lew pointed out a number of benefits in using the VRS:

- improved speed and accuracy over his earlier use of the mouthstick;

- ability to view the screen while inputting data (when he had to concentrate on the keyboard, he could not observe mistakes as they appeared on the screen);

- less cumbersome and more extensive telephone communication by using the Telephone Manager.

One problem identified by Lew in using the VRS is its "memory hungry" nature. The larger the vocabulary of the VRS, the larger the memory required. The minimum memory required for DOS and the voice key files is 350 K. The 640 K of installed memory that Lew had was insufficient to use when resident application programs, such as Sidekick and DESQview, were being used at the same time.

Throughout the project Lew was highly motivated and self-disciplined. He was self-directed in the learning process as demonstrated by his efficiency in work planning, his realistic estimates of the time to be spent on particular tasks, and his optimal use of workdays.

Lew indicated that his increased efficiency in programming with the VRS resulted in his increased job satisfaction. He stated that he now regards himself as an active employee and as an asset rather than as a liability to SHL.

Lew reported that his self-confidence heightened as a result of his work using the VRS. Because of what he was able to achieve, he expressed confidence that he would be ready "to go on to do other things", including mastering new technologies in computer programming.

Lew had no suggestions for improving the training program developed for the MARSH project. He thought that the exercises and projects were well prepared, and that he received more than adequate support from all project participants.

Lew also commented favourably on his taped journal. Its brief dictation became a daily habit, and enabled him to organize himself and to monitor his work activities. By taping his reflections, Lew discovered that he "became more aware of myself and my environment".

Overall, Lew found the project a good experience: he acquired skills and had contact with a wide range of people. Furthermore, through demonstrations, he was able to assist others by disseminating information about the VRS.

According to his employers, Lew's weaknesses in the working environment are related to his physical handicap. There are no intellectual barriers between Lew and his non-handicapped co-workers.

Even with the VRS, Lew is not as efficient as other junior programmers. Computer manipulation is still more cumbersome for him than for them. Assistance is required to insert diskettes and to print hard copies of his work. Lew can handle books or any bound listing by using a mouthstick to turn the pages. To do so in his office while working on the computer, he has to re-position his wheel chair by head and shoulder movements. Because of the effort involved in this repositioning, in a situation where another person would consult a manual, Lew prefers to rely on his memory.

Lew's health is good, except for occasional skin problems, which incapacitate him.[19]

The length of Lew's workday varies. He estimates that he could work up to five hours a day.

To maximize Lew's workday, it is advantageous to eliminate any traveling that can result in fatigue. Consequently the decision was made to allow Lew to work in a remote location. The arrangement has put Lew on par with other computer programmers working for employers at remote locations.

Lew sees his strength, with regard to the VRS, in terms of faster operation of the computer terminal, which enables him to complete assigned tasks. Lew's employer considers Lew's main strengths to lie in his knowledge of technology and in his communication skills. "Lew is articulate, confident, makes people around him relax," according to Dennis Maloney of SHL. Lew's other strength lies in his attitude. He is highly motivated, willing to tackle things, and has no fear of the unknown. His aptitude is that of a competent computer professional. On the basis of Lew's strengths, Maloney perceives an information resource centre to be the most appropriate work environment for Lew. Describing these centres as "pools of knowledge" and "islands of competence", Maloney believes that Lew could work in an advisory capacity there, assisting users of microcomputers. In such an environment he would be much less hampered by his disability than in the speed-competitive field of computer programming. Furthermore, as any resource person, Lew could choose between a physical presence and remote contact via telephone or modem. On those activities that require a good understanding of complex software or strong analytic ability, Lew would be as productive as non-handicapped computer professionals.

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[19] A quadriplegic cannot shift his sitting position and therefore is subject to "sores."

Hence, in this work situation, the gap between Lew and other non-handicapped advisors would be bridged.

Judging the results of the MARSH project, Lew, his employers, and the staff of Queen Elizabeth Hospital agreed that the VRS has the potential of contributing to the improvement of a quadriplegic's quality of life. Beyond its use for computer programming, the VRS can be used for access to all computer functions, such as data banks, word processing and games. The VRS also has the potential of providing quadriplegics with a mechanism for environmental control (e.g., opening doors, turning electrical appliances and lights on or off).

In summary, the VRS improved the efficiency of Lew's computer programming skills. However, Lew's productivity is still not equivalent to that of a non-handicapped worker's, where keyboard intensive tasks are required. His employers indicate that he is well qualified as a resource person for microcomputer users who are not computer specialists.

RECOMMENDATIONS FOR FUTURE USE OF THE VRS

The following criteria should be considered in selecting quadriplegics to work with the VRS on microcomputers:

Physical ability

- a good voice;
- a healthy upper respiratory system;
- an ability to remain upright for the duration of the working day.

Emotional stability

- perseverance.

Motivation

- a strong desire to work on a personal computer.

Intelligence

- aptitude for the development of programming skills;
- a capacity for self-directed learning, since choosing words and definitions for the VRS requires judgement and concentration;

- a good memory.

Practical suggestions for designing training programs for the VRS:

- consider the optimal office layout;
- use a taped journal as a monitoring tool;
- limit unnecessary demands on the time and energy of the trainee, such as the number of demonstrations held during the training program;
- seek external advice regarding ways of improving the trainee's work environment;
- contact Lew Boles in his office at the Queen Elizabeth Hospital (416-597-2537) and rely on his advice, experience and knowledge. He will be glad to co-operate, as he agreed to participate in this project "because it may assist some other quadriplegics in overcoming problems due to their disability."

APPENDICES

APPENDIX A

TABLE AND FIGURES

Table 3

AMOUNT OF WORK AND CONTACTS IN THE THREE PHASES OF THE PROJECT

		Phase I:	Phase II:	Phase III:	Total
Workdays		36	41	16	93
Hours		108.25	149.83	55.38	313.37
Hours per workday		3.01	3.65	3.46	3.37
Contacts					
Phone calls:	VOTEK	9	3	1	13
	IBM	4	5	0	9
	SHL	16	24	5	45
	Total	29	32	6	67
Visits:	VOTEK	3	0	0	3
	IBM	1	0	0	1
	SHL	8	9	2	19
	Total	12	9	2	23
Total contacts		41	41	8	90
Contacts per day		1.14	1.00	0.50	0.97

Figure 8

NUMBER OF WORKDAYS PER PHASE

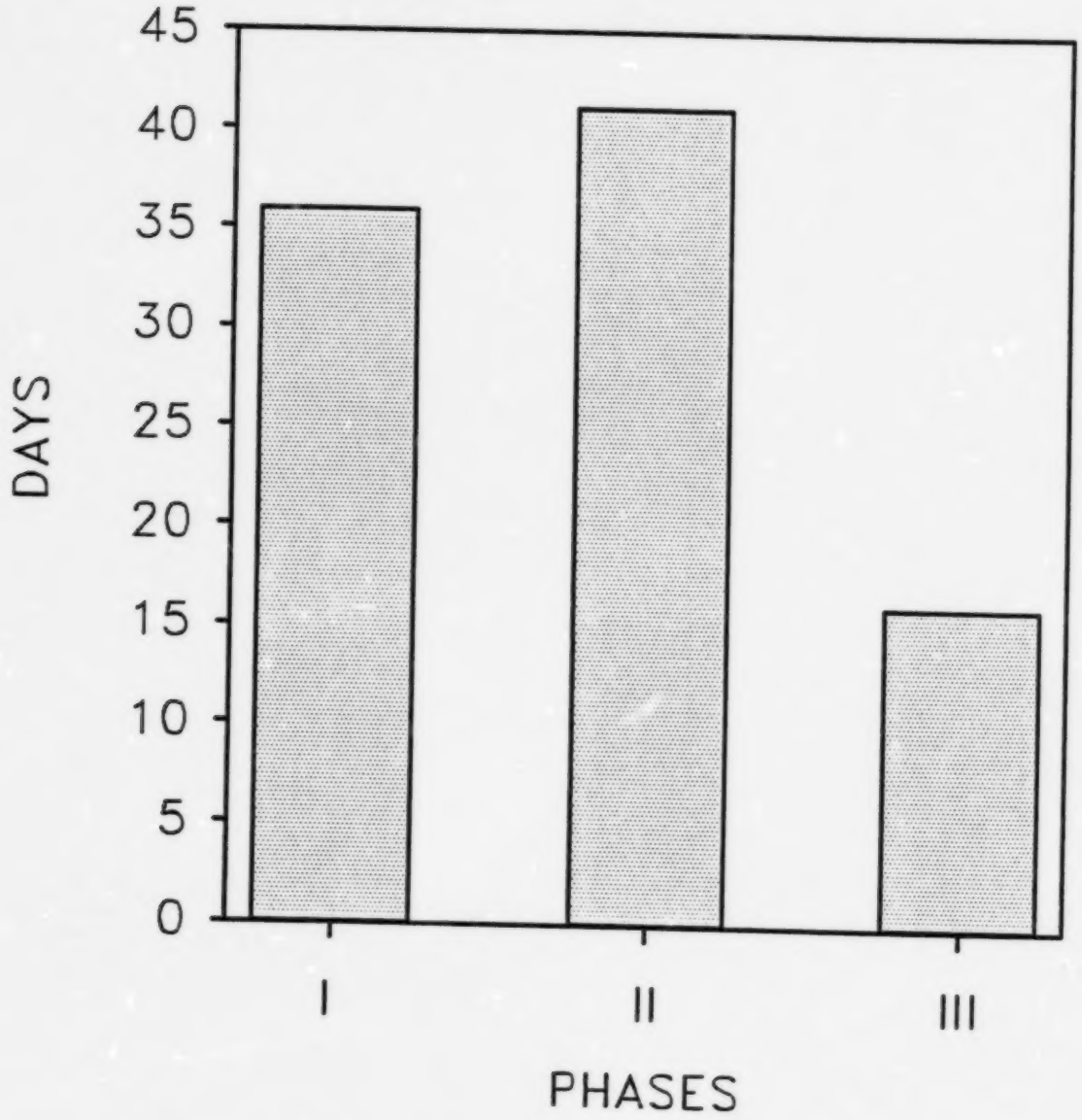


Figure 9

HOURS WORKED PER PHASE

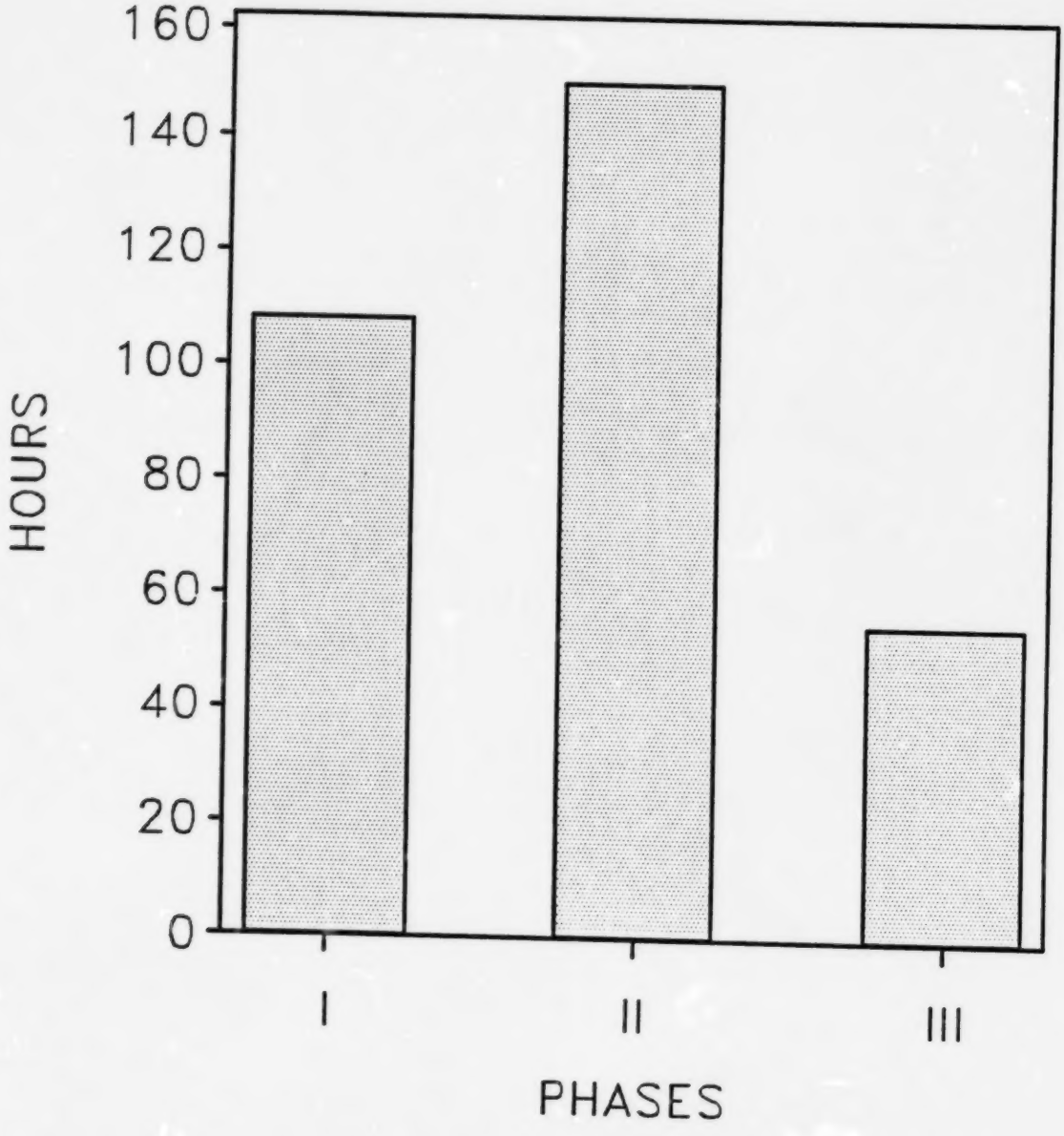


Figure 10

AVERAGE HOURS WORKED PER DAY PER PHASE

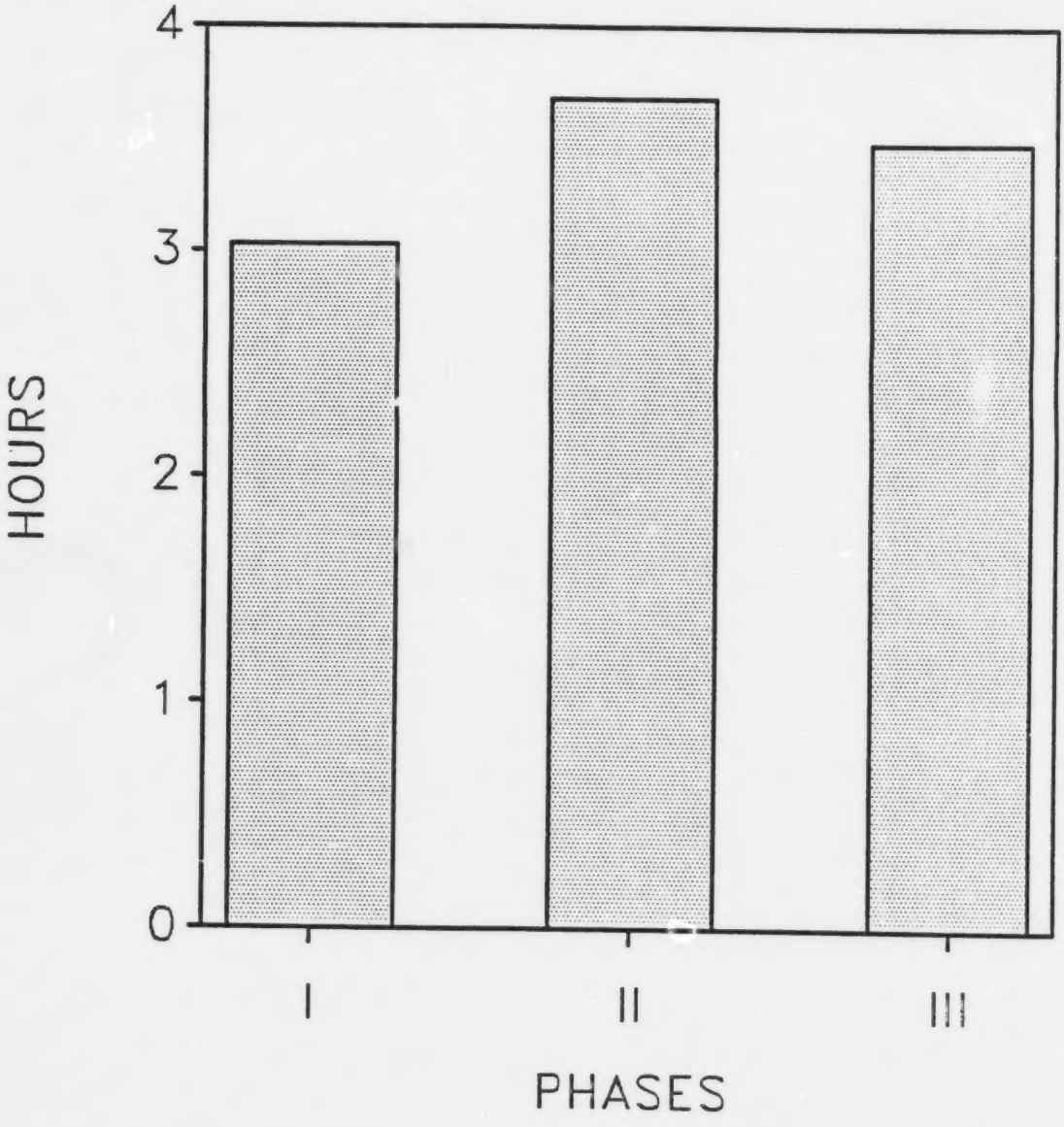
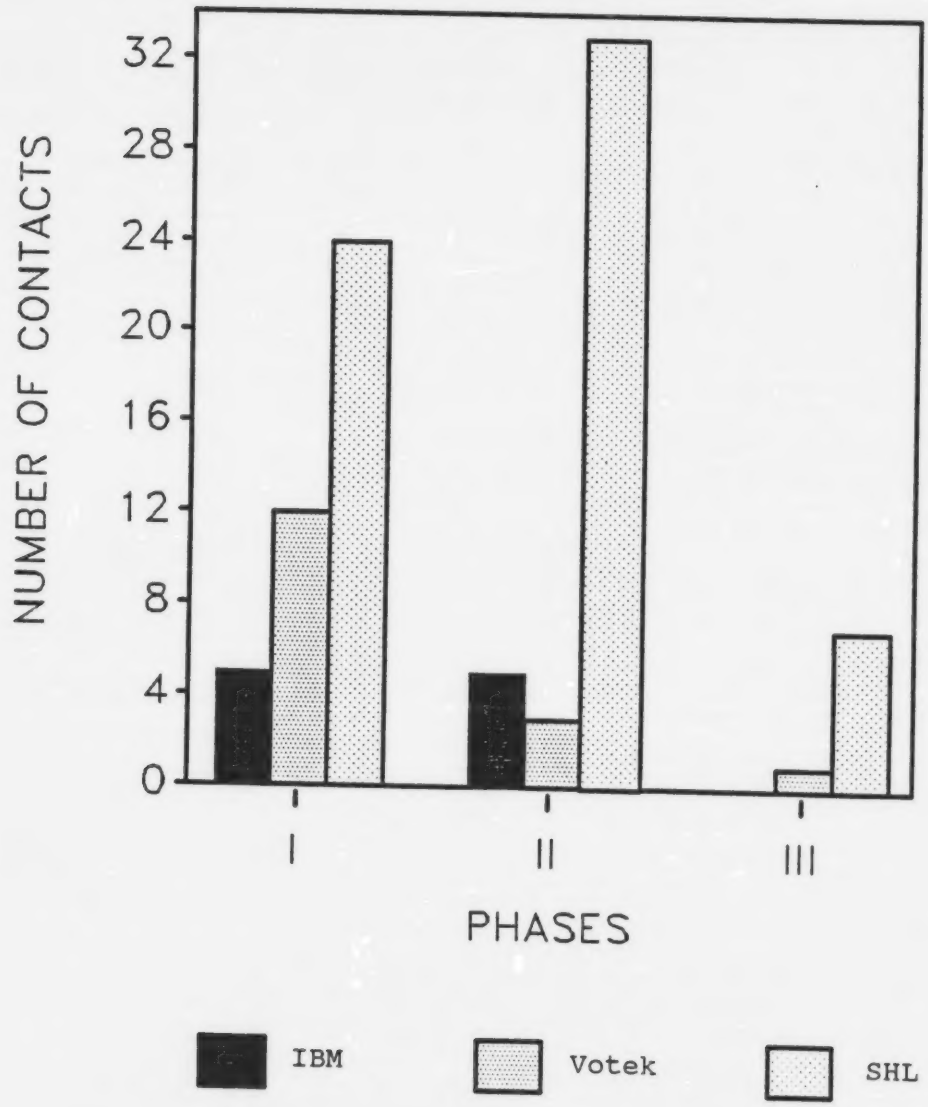


Figure 11

NUMBER OF CONTACTS[20]
WITH IBM, VOTEK AND SHL PER PHASE



[20] Contacts refer to both visits and phone calls for the purpose of clarifying use of the equipment and the content tasks. Excluded were contacts for the purpose of organizing of monthly Steering Committee meetings.

APPENDIX B

DESCRIPTION OF THE SOFTWARE PROGRAMS

Lotus 1-2-3

Lotus 1-2-3 is an all-in-one package that combines Spreadsheet Analysis, Information Management, and Graphics in one flexible package. It includes over 50 functions for building complex models, including mathematical, logical, financial, data base and statistical functions and formulae. Some features include the ability to make presentation quality graphs, on-line help screens, and an interactive tutorial. The number of applications possible are endless, including spreadsheet accounting, statistical analysis of data, data base (information) manipulation and organization, and graphing of data. This package interacts with other popular package files, such as Wordstar.

MS-DOS

MS-DOS is the operating system which ties the components of a personal computer (such as the keyboard, monitor, disk drives and printer) together as a system. The operating system also controls the use and execution of application programs, such as Lotus 1-2-3.

APPENDIX C

DESCRIPTION OF LOTUS 1-2-3 EXERCISES AND PROJECTS

The three training exercises, of increasing complexity, were as follows:[21]

1. **Utilization Analysis:**

   An internal Systemhouse application that indicates the use of time for a particular employee.

2. **Business Centre Financial Reporting:**

   Also an internal application, presenting actual, budget and variance for costs and revenues by Branch Business Centres.

3. **Computer Alternative Analysis:**

   An application built for a client, providing costs for four alternative computer facility arrangements. The alternatives included batch Service Bureau, and purchasing an in-house computer. The figures presented provided a five-year cost projection.

The projects were as follows:

1. **Statistical Process Control System:**

   An application developed for a client, providing management with graphs indicating the consistency of production quality of rubber products.

2. **Groupmark Financial Forecasting Model:**

   A model developed to forecast the Financial Results of the operations of the Groupmark Company Insight Seminars. The company will have a Pro-Forma Income Statement and Cash Flow Projection derived from the Income Statement.

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[21] Prepared by Jeff Russell, SHL

APPENDIX D

TECHNICAL AIDS USED IN CONJUNCTION WITH THE VOICE RECOGNITION SYSTEM

Lew used one technical aid - the mouthstick. The mouthstick is a pointer held by mouth with a retainer-like device, allowing the operator to access the keyboard.

APPENDIX E

LEW'S OFFICE LAYOUT

EQUIPMENT

Lew's office equipment consists of:

- IBM PC-XT personal computer with installed 640 K of random access memory, one floppy disk drive and 20 MB hard disk drive;
- IBM Graphics Printer;
- TOSC (touch operated select control) of the power supply for the computer; it also controls use of the telephone and tape recorder;
- a rotating table, which allows easier access to items that are laid on it;
- a mirror placed behind the computer enabling Lew to observe passers-by and arriving visitors while facing the computer.

The picture on page 40 depicts the layout of Lew's office. For the layout description, see page 39.

Equipment:

(1) Printer

(2) TOSC

(3) Speaker for TOSC (for output from telephone and dictaphone)

(4) Dictaphone (operational by means of TOSC)

(5) Speaker for VRS (for output of response messages)

(6) Pneumatic switch and microphone (Switch controls functions of TOSC. Microphone is for telephone and dictaphone voice input)

(7) Microphone for VRS

(8) IBM PC/XT with monitor

(9) Keyboard for IBM PC/XT

(10) Circular rotating table (Can be rotated in either direction by TOSC for easy access of reading material)

(11) Telephone

(12) Modem

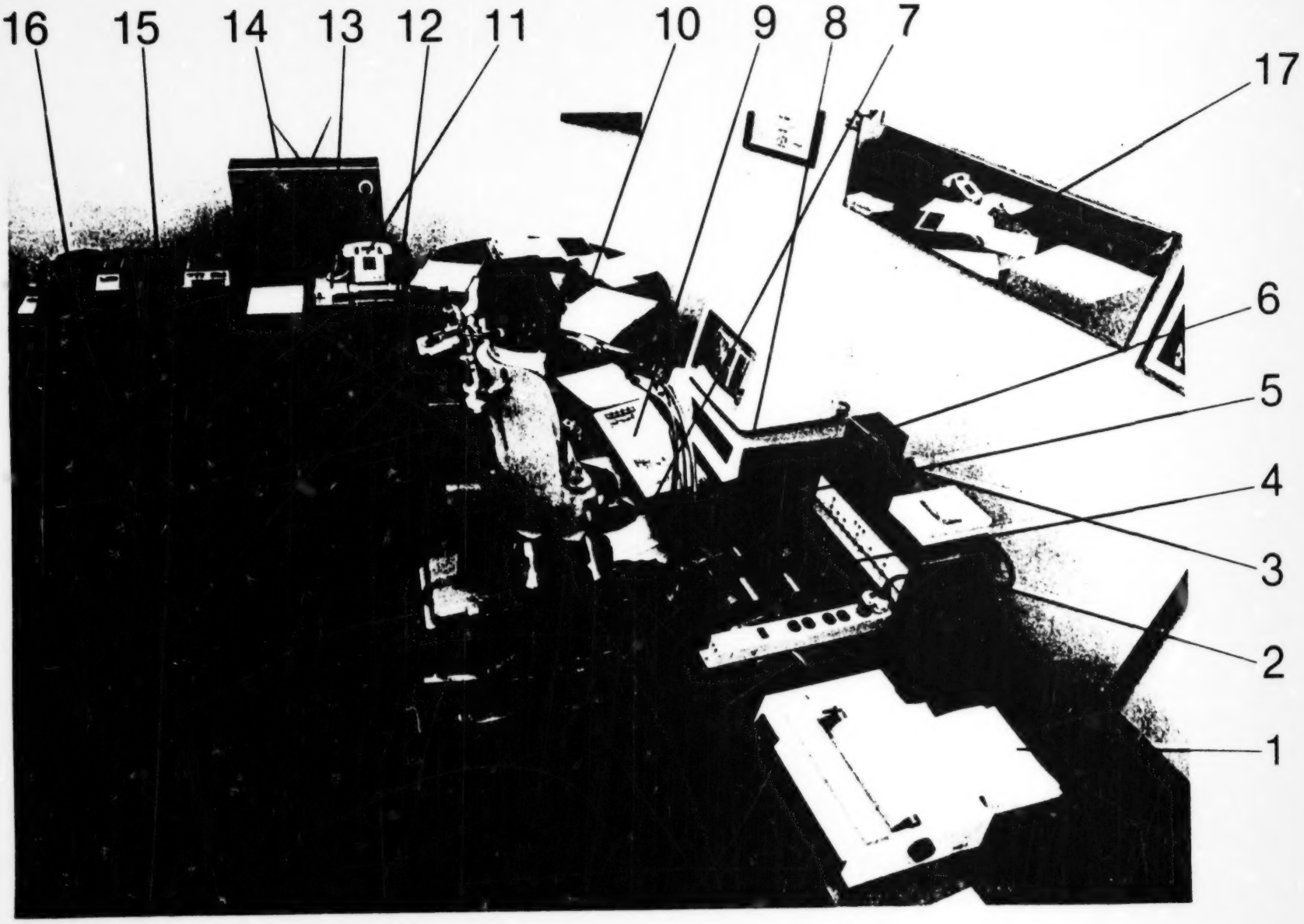
(13) Speaker telephone for hands free use of telephone input and output

(14) Television for use with VCR unit

(15) VCR unit

(16) Taperecorder

(17) Mirror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Ontario
Ministry of Community and Social Services

WINDOW ON TECHNOLOGY

FOR PEOPLE WORKING IN HUMAN SERVICE PROGRAMS

VOL. 2 NO. 4
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Co-operation for employment

The Ministry of Community and Social Services, Systemhouse and IBM working together to make physically disabled people more employable.

Co-operation: John Langstaff, Manager of Scientific and Education Programs, IBM Canada; Dr. Greg Mazuryk, Executive Co-ordinator, Policy Services and Program Evaluation, MCSS; Lew Boles; and Peter Sandiford, President of Systemhouse.

Five years ago, Systemhouse — a company that designs, develops and integrates computer-based information systems — hired a bright young man who had trained to be a computer programmer. The employee, Lew Boles, has an aptitude for data processing and a good understanding of computer technology. He has one limitation: due to a university football accident, he is a quadriplegic who can move only his head, neck and shoulders.

Over the past five years, Lew has worked on some Systemhouse software contracts for the Ministry of Education. Working for three hours a day from an office set up for him at the Queen Elizabeth Hospital, Lew used a mouthstick to operate his computer, pressing the keys on the keyboard one at a time. It is a slow and cumbersome process which made Lew, in spite of his knowledge and intellectual ability, less productive than his peers.

"It just wasn't working," said Dennis Maloney, General Manager at Systemhouse Inc. "It wasn't that Lew didn't have the ability or the aptitude. He put all his effort into the work. It was a technical problem: the equipment was just not easy for him to use."

To help Lew become more productive, Systemhouse looked for technologies that would let his work on the computer match the speed of his mind.

So began an encouraging co-operative project involving 2 private companies, 2 government departments and a motivated, determined individual. The result of their combined efforts may make it possible for people who are quadriplegic to become more productive members of the work force.

Bringing equipment and resources together.

The project began with Systemhouse. Supervisors working with

Continued on page 2.

What's Inside?

A computerized interview helps clinicians assess problem children and youth. See page 5.

The human side of emergency response systems. Page 8.

Technology to help people who are developmentally handicapped. See page 10.

Workshops ... and more workshops. Page 4, page 11, and page 12.

Lew started to look at recent developments in microcomputer and voice recognition technology. "The industry shift to the microcomputer offered us a powerful, flexible system with which to work," Maloney explained. Part of the mainstream of data processing, the microcomputer (or personal computer) can be individually controlled and can handle a wide range of high level programming languages as well as software packages. Add to the microcomputer an audio recognition unit, then an individual can "train" the computer to recognize a voice instruction and convert it into a computer command.

This technology could allow Lew to bypass the painstaking, time-consuming process of entering data with a mouthstick and, instead, "write" with his voice. Systemhouse found an audio recognition unit that would plug into a standard personal computer. "Recent developments in the technology have reduced the size and cost of the unit to the point where it's a practical, affordable alternative to using the keyboard," said Maloney.

Convinced that this new technology would allow Lew to be more productive — and might offer a way to improve the quality of life for many other severely disabled people — Systemhouse began to look for support for the project. The company approached IBM, who agreed to provide a PC for Lew's use. Systemhouse also contacted the Ministry of Community and Social Services. The ministry's Vocational Rehabilitation Services purchased the voice recognition unit for Lew which was installed with his PC.

Lew Boles at his computer, with the microphone and speaker that connect with the voice recognition unit.

The Applied Program Technology Unit — a ministry group that promotes the use of technologies which increase the ability of handicapped, disabled or dependent people to look after themselves — recognized the potential of the microcomputer/voice recognition technology. Staff of the Applied Program Technology Unit have worked closely with Systemhouse and Lew to set up the project and are currently in the process of evaluating the equipment and Lew's ability to use it. How much training is required? What are the benefits? With the equipment, will Lew be able to compete in the workplace? Will he be more employable? Will other disabled people be able to use similar equipment? Are there other ways in which the technology can be used to promote independence?

Cleo...hibernate. Or how to use a voice recognition unit.

"I call her Cleopatra, because she's a temptress." Lew Boles explained how his voice-activated computer system works. "To start the system, I say her name: 'Cleo'. To get her to sleep or to close the system down while I'm talking to someone else in the room, I say 'hibernate'."

The voice recognition unit is a card that can be inserted into any IBM-compatible personal computer. It works in conjunction with a microphone, a speaker, and a software program called Keymaker. With the unit, Lew can speak to the computer and see data appear on the screen as though it had been entered on the keyboard.

"I established a vocabulary or word set for each software program I use. The word set for the alphabet followed the military code: arthur, bravo and so on. But for programs such as DOS and Lotus, I chose my own voice commands. It's easier to master because you're not memorizing a long list of commands; you're setting your own as you go."

Lew (or someone else) feeds in the key strokes or label for which the voice command will substitute, and then Lew records the command words using Keymaker.

Words like "up", "down", "right", "left" and "end" move the cursor on the screen. In Lotus 123, the voice command might be: "Change column width" to substitute for the keyboard sequence: "/wcs". Commands or word sets can be changed at the discretion of the user.

"There's some indication that this system is much more accurate than the hand eye coordination needed to use a keyboard," Dennis Maloney, General Manager at Systemhouse said. The system is certainly fast. There is virtually no delay between the voice command and the response on the screen.

Although most voice commands go directly to the screen, the audio recognition unit also allows for a verbal response to some commands or questions. Lew uses the speaker feature to check and change vocabulary tables. While working on the computer, Lew might ask, "Where am I?" The speaker might answer: "In DOS words." Lew could then command: "Lotus words", and the speaker would

At the heart of the project, a man with a lot of determination.

Lew has just completed his training with the new equipment. The audio recognition unit has proven to be very easy to use. The equipment supplier gave a brief initial demonstration and has since made two minor adjustments to the equipment. The rest Lew has done on his own, using a written manual and a tutorial that runs on the computer. He "trained" the computer to recognize his voice.

Lew mastered the voice commands that activate the audio recognition unit in less than 5 hours, and then went on to tutorials and training exercises in the computer's disc operating system and in software packages. His total training time was only 108 hours over 2 months.

Although it is too early to evaluate the impact the equipment will have on Lew's work, it is clear that his productivity has increased. He can operate the computer as quickly as he can talk. For Lew, it is an exciting process — one that helps him in his efforts to work competitively.

"Before, I was very frustrated," said Lew Boles, in describing his experiences with the old system. "It was very tiring using the mouthstick — and slow. I knew I wasn't able to work fast enough, and it was difficult for everyone. Now, I'm able to work faster. The computer accepts continuous speech and is 98% accurate. It's also easier for others to contact and work with me."

In addition to operating the computer, Lew can use the voice recognition unit with a powerful version of a phone answering machine. Using voice commands and the computer, he can phone people, send pre-recorded messages, leave messages for callers who have a password into the system and even phone the computer from another location and get his messages.

Everyone involved in the project — the Ministry of Community and Social Services, Systemhouse, IBM — acknowledges that the key to its success is Lew Boles. A systematic thinker who has an incredible memory and a well-developed ability to concentrate on his work, Lew is a remarkable man. He has been able to memorize all the verbal cues he needs to operate his equipment and is blessed with a strong voice, which makes it possible for him to run the audio recognition unit easily. He has the determination to make it work.

Giving "equal opportunity employment" a special meaning.

During the evaluation of the system, Lew has duplicated actual Systemhouse client projects. "The quality of the work has been excellent," Maloney reported. "The programs he's written have been as good as any the other programmers wrote. In some cases, he improved on what had been done. We're very pleased."

For Systemhouse and IBM, it has been gratifying to watch the progress Lew has made with very little supervision or support.

For the Ministry of Community and Social Services, it is encouraging to see private sector companies so committed to hiring and helping people who are physically disabled. The more that employers can be directly involved in developing ways to help disabled people become more productive employees, the more everyone will benefit. With co-operative efforts such as this one between the Ministry of Community and Social Services, Systemhouse and IBM, the future of employment for disabled people becomes much brighter.

Continued on page 4

respond, "Changing to Lotus words." In this way, Lew can check quickly and have immediate access to the commands needed to drive the program.

According to Lew, the unit is "speaker-dependent". "Because the unit is trained to my voice, I'm really the only person who can use the system. It might respond to other voices but would probably just print garbage on the screen," he explained. "The only other people who can use the system are those who have recorded passwords into the cmputer. The unit will recognize their voice and password, but will only give them access to the messages I've left on the system for them." The audio recognition unit can add a whole new dimension to the concept of the "personal" computer.

If the user's voice is not always consistent, the unit's tolerance can be adjusted to understand a wider range of variation in the way the commands are said. This ensures the unit will not misunderstand the voice commands.

Sound rather than word oriented, the unit can be used by anyone capable of repeating consistent sounds. While someone who stutters might not be able to master the unit, someone who is nonverbal but capable of a range of consistent sounds might well be able to use it. Orientation is fast and easy. For someone like Lew Boles who is familiar with computers and highly motivated, it took about 20 minutes to understand how the unit works. In a month's time, he had developed the word tables and was using the system easily.

The voice recognition unit used by Lew is available from VOTEK in Scarborough, Ontario, at a current price of $2,415 Cdn. The company also offers a support package for $600 Cdn. that runs for two months and helps users set up and record vocabulary tables.

If you would like to know more about the voice recognition unit, Lew Boles will be offering a series of demonstrations and discussing the training required and the system's various uses.

Demonstrations are scheduled for January 23, 28 and 30, 1986, between 1:30 and 3:30 pm at the Queen Elizabeth Hospital. Participants will necessarily be limited to five or six per afternoon, so please reserve a time with Anne-Marie Gardner at the APT Unit: (416) 965-3204.

Continued from page 3.

Co-operation for employment

What makes a company like Systemhouse go to this much effort to help someone like Lew Boles? According to Lew, "They're a 'people' company. They care about their employees and work with them."

"We do feel strongly that our company is our people. It's what we market really — our employees and their knowledge and skills. Any investment in our employees benefits the company," Maloney said about Systemhouse's approach. "Lew was hired during the Year of the Disabled as part of a special program to see if disabled people could become productive commercial programmers. Although the original program didn't work, Lew is not the kind of person you give up on — because he never gives up. We're not health care workers or social workers, we're data processors. We could see that he had a lot of ability, and we just wanted to find some way to let him use it."

Maloney also spoke about the future. "With his understanding of microcomputer programs and with the telephone system he now has, Lew will be working in our Information Centre. Clients who have problems with certain programs will ask Lew for advice. Lew will work on the computer to find solutions to those problems, and then he'll either call the clients back directly or else leave messages on the system for them."

When asked if he was pleased with the way his career is developing, Lew was enthusiastic. "Definitely," he said. "We're in an information age, and I have the knowledge and now the means to be part of it."

The Ministry of Community and Social Services hopes that the voice recognition unit will help Lew control more of his environment and provide a relatively inexpensive technology that will help other physically disabled people become more productive and more employable.■

Upcoming Meetings and Workshops

For professionals working in rehabilitation...

The annual Ontario Rehabilitation Workshop Council (ORWC) conference will be held June 25 to 27, 1986 at Carleton University in Ottawa.

Titled "Working Through the '80s", the conference will feature workshop product demonstrations as well as exhibits by manufacturers who supply services to workshops.

Conference themes and workshop sessions will include:

- ☐ Work simplification, jigs, contract pricing and packaging (for front-line staff).
- ☐ The minimum wage issue.
- ☐ Health and safety concerns in the workshop.
- ☐ Deinstitutionalization and community day programs.
- ☐ Behaviour management in the workplace.
- ☐ Non-verbal communication.
- ☐ Physical assistive devices.
- ☐ Sexuality and the workshop.

Registration fees range from $175 to $225, and are based on membership and accommodation. For more information, contact Jim Mitchell, Chairman, Eastern Chapter, ORWC, Royal Ottawa Regional Rehabilitation Centre, 505 Smyth Road, Ottawa, Ontario K1H 8M2 (613) 737-7350 ext. 474.

For professionals working with people who are developmentally handicapped

"Controversial Issues in the Field of Developmental Disabilities" — the 13th annual conference of the Ontario Chapter of the American Association on Mental Deficiency (AAMD) — will be held March 5 to 7, 1986 at the Westin Hotel, Ottawa, Ontario.

Keynote speakers and conference participants will examine issues such as legislation, medicine, technological applications, education, advocacy, religion/cultural values, ethics and treatment methods.

For more information please contact: Dr. Chris Stavrakaki, Chairperson, AAMD, Royal Ottawa Hospital, 1145 Carling Avenue, Ottawa, Ontario K1Z 7K4 (613) 722-6521 or Dr. Maurice Feldman, Behaviour Research Programme, Surrey Place Centre, 2 Surrey Place, Toronto, Ontario M5S 2C2 (416) 925-5141 or Dr. Alex Rnic, Ministry of Community and Social Services, 10 Rideau Street, 7th Floor, Ottawa, Ontario K1N 9J1 (613) 234-1188.

Computer Use in Social Services...in Canada.

Computer Use in Social Services Network (CUSSN) is a nonprofit association of professionals interested in exchanging information and experiences on using computers in social services. CUSSN has invited its Canadian members (and anyone in Canada working with computers in social services) to put together a Canadian issue of the CUSSN newsletter.

It's a chance to illustrate computer use in social services within the unique national cultures, traditions, legislation and geography of Canada. The issue will contain descriptions of Canadian projects in the areas of: decision support systems, management information systems, local area networking and bulletin board services, telecommunications, case management, computer-aided learning, computer-assisted training, behaviour management and other topics deemed to be of interest.

If you are interested in contributing to the special Canadian issue, please send a copy of your article to:

Kim Lambert
CUSSN Canadian Co-ordinator
University of Toronto
256 Bloor St. W.
Toronto, Ontario
M5S 1A1
(416) 922-9338
FIDONET-CANADA-1 NET 11, NODE 700

- ☐ Articles should be submitted by February 28, 1986.
- ☐ Include your name, title and any other identifying information.
- ☐ Articles should be between 1500 and 3000 words.

The CUSSN newsletter, which is published four times a year, has no editing services. Please keep your article within the requested word limit. As far as possible within space restrictions, the newsletter will include all submissions.

In addition to producing a regular newsletter, CUSSN runs a skills bank, a software clearing house and special interest groups. For more information about the organization, contact Kim Lambert, the Canadian Co-ordinator, or write to Dick Schoech, Assistant Professor, The University of Texas at Arlington, Graduate School of Social Work, P.O. Box 19129, Arlington, TX 76019 or Lynn Harold Vogel, Assistant Professor, University of Chicago, School of Social Service Administration, 969 E. 60th St., Chicago, IL 60637.

APPENDIX G

HISTORY OF LEW BOLES

Lew Boles was born May 11, 1949. In November 1967, he suffered a football accident that resulted in quadriplegia. Lew took a number of computer science courses at the University of Toronto from 1969 to 1972, and took additional courses in 1977 and 1978.

In 1979 and 1980, Lew's aptitude for computer programming was assessed by members of the Department of Computer Science at Queen's University and of the Business Department of St. Lawrence Community College in Kingston, Ontario. Findings from this assessment were summarized in May 1980 by L. McCurdy, of the Business Department of St. Lawrence College: "Initial testing, using the IBM Programmer's Aptitude Test, indicated that Lew did, in fact, possess a high aptitude for work in this field. Encouraged by this result, we then proceeded to conduct a much more comprehensive evaluation, which tested not only aptitude, but also motivation, adaptability, and the effect of Lew's handicap on his ability to work as a programmer. To accomplish this, Lew was given a series of computer programming assignments to do, using the personally adapted computer terminal. He was to write the programs in the BASIC Programming Language.

"The actual test took place over a ten-week time period. During this time Lew was required to learn how to use the computer terminal, learn the BASIC Programming Language and then write and test a series of programs, using the equipment and the language. The test results were very positive. Lew learned the language on his own, with very little assistance. He overcame many technical problems with his equipment, and produced good solutions to the programming assignments."

From these test results, it was concluded that Lew could be successfully employed as a computer programmer.

Subsequently, Lew was trained as a computer programmer. The project was titled: "Quadriplegic to Computer Programmer." The rehabilitation team involved in Lew's training, included representatives of the Kingston Office of the MCSS, the Department of Rehabilitation Medicine at Kingston General Hospital, the Computer Development Group of Queen's University, and the Business Department of St. Lawrence College.

During the project, Lew used special interface equipment. Queen's University supplied Lew with a DEC LSI-II, which was connected to its Burroughs main frame-computer, and with terminal-emulation software. It was soon determined that using a mouthstick and a keyboard would not allow Lew to be sufficiently productive, so a computer slate (i.e. graphic input tablet) was acquired. The

computer slate was programmed to enable inputting and editing of characters and numbers, with a facility similar to the normal use of a pad and pencil.

In 1980, Lew was hired by Systemhouse, Ltd. and for the succeeding five years, worked on a variety of contracts, primarily for the Ministry of Education.

Despite the best efforts of Lew and of those working with him, the projects Lew began were not completed. It was soon recognized that Lew, working with a mouthstick in a non-standard technical environment, could not work fast enough to compete in a commercial environment with a programmer who was not physically disabled. While Lew's productivity was low, he did have an aptitude for data processing and a good understanding of the technology.

Both Lew and his employers felt that his productivity would be increased if he were able to program the computer without relying on the standard keyboard.

The MARSH project was initiated with the expectation that such a solution would be found in voice recognition technology.

APPENDIX H

OTHER QUADRIPLEGICS USING COMPUTERS

The rapid growth of computer technology and recent developments in voice recognition systems are seldom linked to physically disabled individuals as potential or actual users. In light of the fact that writings on assessing disabled persons in the workplace are virtually non-existent, the absence of links between computers and disabled persons appears to be affected by the prevailing stigma attached to handicapped workers.[22]

Only four instances of quadriplegics using computers for programming tasks are mentioned in the literature reviewed.

a) Mark, a high level quadriplegic and member of a training program at the Maryland Rehabilitation Centre, works on a Texas Instruments Speech Recognition System. Mark's last name and age are omitted.

   Source: Larry Hiner and Bud Rizek, "Voice Activated Computing", Closing the Gap, June/July 1985, p. 19-20.

b) Rick Pilgrim, 29 years old, a high level quadriplegic, can only move his eyes and mouth. He uses the Voice Data Entry System, produced by small Scope Data Electronics (presently owned by Interstate Electronic Corporation, based in Anaheim, California). Mr. Pilgrim works as a documentation and system analysis specialist for the U.S. National Institute of Health.

   Source:Bowe, p. 33-36.

c) Kevin Riley, 31, works as a programmer/analyst for the IBM Business Centre in Bethesda, Maryland. He uses the IBM-PC with the Intel Electronics speech recognition unit. In addition, he uses the Prentke Romich Environmental Control Unit and BSR Command Module to maintain control over his environment. With the help of these units, Mr. Riley has started three small companies: one provides transportation for disabled people in the area he lives in, another does

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[22] Bowe reports on paternalistic attitudes to disabled workers in Europe, which he links to a European tradition of governmental care for persons with disabilities. He found in "many European nations . . . sheer incomprehension when (he) began talking about putting special-needs persons to work in . . . offices." (F. Bowe, Personal Computers and Special Needs, Berkeley: Computer Books, 1984, p. 56).

construction work and a third handles a nursing registry.

Source:Bowe, 1984, p. 36-38.

d) Phillip Craddock, 19, intends to enter computer classes for handicapped people at Harbourfront. Presently he uses a home computer, striking the keys with a pencil attached to wrist cuffs.

Source:The Globe and Mail, June 13, 1985.

APPENDIX I

ADDITIONAL SOURCES OF INFORMATION ON TECHNICAL ASSISTANCE TO THE HANDICAPPED

Newspaper Articles[23]

Frank Jones: Life for disabled better - for some.

(The Toronto Star, August 15, 1985)

> Darrel Murphy, 31, is a quadriplegic. He lives in one of 14 specially equipped apartments in the new Metro Housing Building at Weston Road and Eglinton Avenue West. The apartment has 14 male residents. All residents, averaging 22 years of age, are victims of accidents, in which they broke their necks or backs. Within the building, the tenants have employed their own staff of 12 to get them out of bed and on their way to school or work. The cost of their housing and attendant-care is assisted by the government.

Donna Walters Kozberg, "Computer Programming: A job for today and a career for tomorrow", (Paraplegic News, July 1984, pp. 22-23).

The article discusses a computer programming, work-at-home alternative for disabled men and women, organized by a non-profit organization Lift Inc. (137 Russek Drive, Staten Island, NY 10312). Founded in 1975, the Lift program operates in many large cities from the east coast to Hawaii and assists disabled persons to train and work as computer programmers. The program has four components:

1) Election and matching of candidates with corporate clients,

2) Education of candidates,

3) Employment of programmers by Lift under contracts with corporate clients,

4) Employment of programmers by corporate clients.

Lift's training program consists of a six month self-administered audio-visual course, entitled "Computer Programming for the Physically Disabled." This course is designed around a series of audio-visual lessons published by DELTAK, Inc., a Chicago-based firm.

Jerry Gladman, "Lending a helping hand", (The Sunday Sun, December

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[23] Presented here by date of publication.

15, 1985)

> The Neil Squire Foundation was established in 1984 as a non-profit organization in Vancouver. Its aim is research and development of technical aids for the disabled. The foundation developed a program "Computer Comfort", which is designed to teach computer basics to the disabled. Using university students as full-time instructors, the organization dealt with more than 500 severely disabled adults. Another significant development of this foundation is a low-cost, easily programmed robotic arm, which is attached to the body. Its design was based on a Wish List of the things the disabled wanted it to do. Among expressed needs were: shaving, combing hair, turning newspaper pages, putting on glasses, taking something off a shelf, and inserting a disc into a computer. An aim of the foundation is to develop a network with scientists, researchers and rehabilitation experts.

Larry Hannant, "Skin response can control computers", (The Globe and Mail, June 28, 1985).

> A Vancouver technology promoter, Danny Reco and Richmond Hi-Tek Products, a division of Parry Software, Ltd. of Richmond, B.C., have acquired the license to make and market in Canada a device called Touch Stone. The system has been developed by Behavioural Engineering of Scotts Valley, Calif. This device, which works by amplifying the changes in electrical conductivity, "will let even novices perform simple computer functions just by putting their minds to it." Although some scientists have doubts about this system, others believe that quadriplegics might use it to control a computer.

Other Sources

"Closing the Gap", founded by Dolores and Bud Hagen, began in 1981 as a newspaper committed to providing the latest in information crucial for delivery of computer technology to handicapped and disabled persons.

In 1984, the Closing the Gap Training and Resource Centre was opened. (P.O. Box 68, Henderson, MN 56044, Tel. (612) 248-3294).

The centre offers the following:

- a newspaper "Closing the Gap", published six times a year; it reviews software and hardware from around the world and points out how technology can close the gap between handicapped individuals and the rest of society. Back issues of the newspaper and the 1985 Resource Directory (a guide to the selection of microcomputer technology for special education and

rehabilitation) are available.

- Closing the Gap Bookstore, specializing in books and booklets on planning, selection and implementation of micro-computer technology for special needs populations.

- Workshops, seminars and consultations.

The following report is available:

Rogert W. Patillo: "Unlocking the Doors: An examination of the Impact of Computer and High Technology on Unemployment Opportunities for the Physically Disabled" (Health and Welfare Canada Assistance and VRDP Program, Social Services Program Branch, March 1986.

Subscriptions for newsletters on voice recognition systems are available from:

Speech Technology (Newsletter)
Medical Dimensions, Inc.
P.O. Box 1121
Gracie Street
New York, NY 10028

Voice News
Stoneridge Technical Services
William W. Crutz, Editor/Publisher
P.O. Box 189
Rockville, Maryland 20850
(301) 424-0114